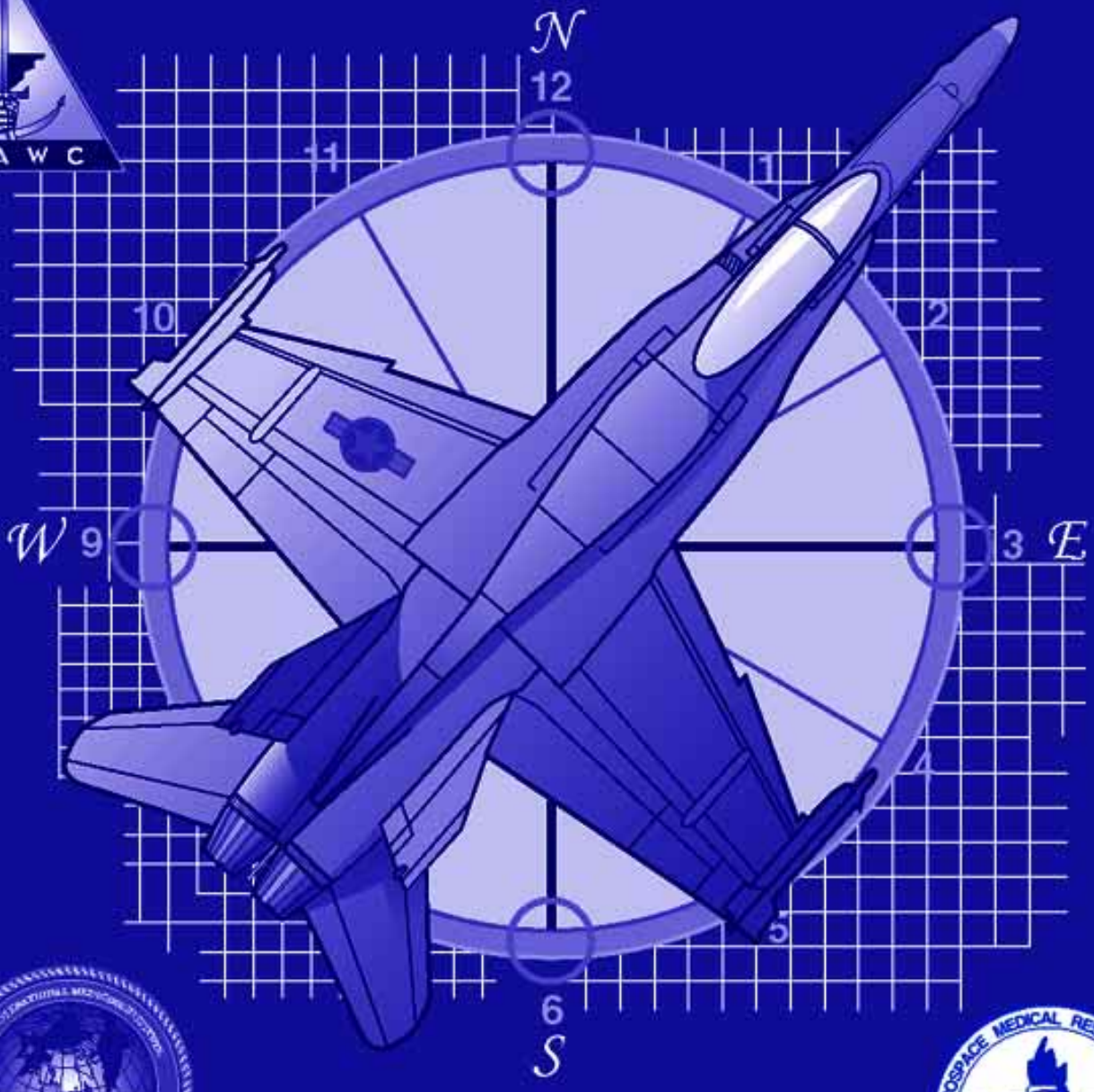
Performance Maintenance

DURING CONTINUOUS FLIGHT OPERATIONS



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• A GUIDE FOR FLIGHT SURGEONS •

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PERFORMANCE MAINTENANCE

During Continuous Flight Operations

A GUIDE FOR FLIGHT SURGEONS

POC For Comments and Recommended Changes for Future Editions

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FOREWORD

MEMORANDUM FOR NAVY FLIGHT SURGEONS, AEROSPACE MEDICINE SPECIALISTS, MEDICAL COMMANDERS, COMMANDING OFFICERS, AND OFFICERS IN CHARGE

Subj: PERFORMANCE MAINTENANCE MANUAL

Encl: (1) PERFORMANCE MAINTENANCE DURING CONTINUOUS FLIGHT OPERATIONS—A GUIDE FOR FLIGHT SURGEONS

1. I am pleased to approve enclosure (1) for use by flight surgeons. As stated in the manual, fatigue in sustained, continuous naval flight operations is expected and can lead to poor flight performance and increased aircraft mishap potential. Thus, preventing fatigue and maintaining optimal performance in sustained operations are primary concerns for squadron commanding officers and their flight surgeons. The uses of sleep, combat naps, proper nutrition, and caffeine are currently approved and accepted ways flight surgeons can recommend to prevent and manage fatigue. However, in sustained and continuous operations these methods may be insufficient to prevent fatigue and maintain combat-ready performance. Properly administered use of stimulant and sedative medications, i.e., Dexedrine, Ambien, and Restoril, is an additional measure flight surgeons can recommend to manage fatigue and maintain pilot performance in continuous, sustained naval flight operations.

2. Historically, the use of medications to maintain performance in aviators is not a new idea. Enclosure (1) notes that the British and Germans used amphetamines during WWII in their pilots. Later, the British used sedatives to regulate sleep for pilots during the Falklands conflict. The U.S. Air Force and Navy used amphetamines in aviators during Vietnam, and the Air Force used both amphetamines and sedatives during Desert Storm and have used both off and on since. Use in all these circumstances was reported to be safe and effective.

3. The fleet's request to use stimulant and sedative medications during contemplated continuous and sustained flight operations provided the impetus to develop enclosure (1). Naval Strike Air Warfare Center collaborated with Naval Operational Medicine Institute (NOMI) and Naval Aerospace Medical Research Lab (NAMRL) to develop a protocol for appropriate use of stimulants and sedatives. Enclosure (1) was subsequently recommended by the Aeromedical Advisory Council (ACC) and approved by NOMI as the acceptable standard of care guide for flight surgeons. NOMI appropriately cautions that use of stimulants and sedatives should be used only in combat or during exceptional circumstances of operational necessity and only with authorization by the squadron commanding officer.

4. Enclosure (1) is an important demonstration of Navy Medicine's commitment to fulfill its primary mission–support to the fleet. Bravo Zulu to all those who "made it so!"

R.A. NELSON
Surgeon General of the Navy

Basic Principles

THINGS TO KEEP IN MIND

- **Aviators are normally tired before sustained operations begin (preload).**
- **Sleep cannot be stored or built up prior to continuous or sustained operations but preload can be reduced.**
- **Performance fluctuates predictably over the day (your circadian rhythm).**
- **Sleep loss, circadian rhythm disruption and hard work combine to produce fatigue.**
- **Fatigue is not due to lack of motivation or attitude.**
- **Poor performance is the ultimate price of fatigue in continuous operations.**
- **We manage maintenance, fuel and weapons; we can also manage fatigue.**

Continuous And Sustained Operations

TWO TYPES OF ACTIVITIES THAT TIRE AVIATORS

Operations that produce fatigue can be divided into two broad and sometimes overlapping categories:

Continous Operations (CONOPS)

– Extend over 24 hours at a “normal” rate
– Not necessarily longer hours per individual
– Workers are relieved at the end of a shift and return later
– Individual may work different hours which may conflict with the circadian rhythm
– Sleep may be intermittent, broken and unrestorative
– Most pilots use “CONOPS” to refer to contingency operations

Sustained Operations (SUSOPS)

– Involve individual continuous performance longer than 24 hours
– Work is continued until a goal is reached
– Sleep deprivation is common
– Prevalent in ground warfare

Tactical aviators most commonly participate in continuous operations with periods of sustained operations. Unlike a ground war aircraft availability and flight duration limit periods of duty. Back on deck, however, significant fatigue may be generated by planning, management responsibilities or lack of crew rest after returning from the last mission. The conduct of war has changed. Previously limited by daylight, around-the-clock preparation or actual combat is now the norm.

Paratroopers at Normandy participated in a sustained operation which resulted in debilitating fatigue and a remarkable decrease in their ability to perform:

> They were dull-eyed, bodily worn and too tired to think connectedly. Even a 30 minute flop on the turf with the stars for a blanket would have doubled the power of this body and quickened the minds of its leaders to ideas which they had blanked out. But no one thought to take that precaution. The United States Army is indifferent toward common-sense rules by which the energy of men may be conserved in combat....Said Captain Patch of his people on the far right, ‘They were so beat that they could not understand words even if an order was clearly expressed. I was too tired to talk straight. Nothing I heard made a firm impression on me. I spoke jerkily in phrases because I could not remember the thoughts which had preceded what I said.’ (1)

Sleep

MORE IS BETTER ... UP TO A POINT

- CO's, XO's, department heads and strike leaders will sleep far less than normal the week prior to the first strike because of the multiple demands of running the squadron, planning and flying.
- Sleep cannot be stored or built up but the preload of sleep loss can be reduced (2).
- Prior experience with sleep loss does not provide training to maintain performance.
- The minimum amount of sleep to maintain performance during sustained operations is 4-5 hours per day. Fragmented sleep is less effective (2).
- Many studies indicate the important factor is the total amount of sleep, not the amount in a specific sleep cycle. The body tends to adjust for the stage of sleep if given enough time for sleep (2).
- Resting on a bed is not the same as sleep. For some unknown reasons, the regenerative properties associated with sleep cannot be accomplished by just rest (2).
- Combat naps of 10 minutes or more will help maintain alertness and job performance. There is some risk from "sleep inertia" lasting about 5 minutes after awakening characterized by confusion, sluggishness and uncoordination (3).
- "Non-habitual nappers" experience sleep inertia more frequently. Taking more naps (practicing) appears to reduce this problem (4).
- It is easiest to initiate sleep twice a day; in the early afternoon and just before the normal sleep time.
- Alcohol, while initially relaxing, significantly worsens the duration and quality of sleep.
- Sleeping more than 10 hours may cause "sleep drunkenness" and should be discouraged, even after a period of sleep deprivation (2).
- Caffeine interferes with sleep. During Desert Storm aviators who drank less caffeine on non-flying days took longer naps (5).

THE COMBAT NAP

Conventional wisdom suggests that the combat nap is sought by junior officers as a means of avoiding the executive officer. From the standpoint of performance maintenance, however, it is probably the most useful tool we have during continuous and sustained operations. Unlike other interventions, sleep reduces fatigue itself. In other words, it treats the problem not the symptom. Research suggests that a period of sleep as short as 10 minutes improves objective functioning. The only drawback to the nap is that some individuals awaken disoriented and lethargic which lasts from 5 to 20 minutes. "Practice" naps may reduce this period of sleep inertia.

It is strongly recommended that commands encourage, and at times mandate, combat naps.

Circadian Rhythms

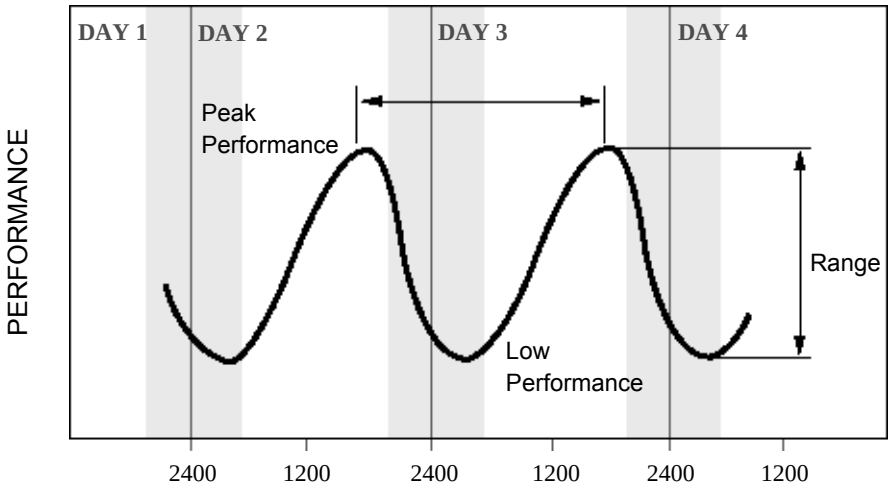
EARLY MORNING IS THE HARDEST TIME

There are numerous cyclic body rhythms in man that collectively are described as circadian rhythms. The influence of the circadian rhythm on aviator performance during continuous operations can be dramatic and warrants both appreciation and understanding.

Experiments carried out in isolation (where all environmental cues have been removed) place humans on a free-wheeling cycle resulting in a spontaneous period commonly close to 25 hours. Entraining agents, however, reset the biological clock daily. These include light and darkness (the most powerful cues), sleep, meals, social activities and clocks.

A general rule is that your body will adapt 1.5 hours/day when traveling east and 1.0 hours/day when traveling west (6). This does not mean that a person cannot perform before all his/her systems are locked on; just that the performance will not be maximized.

THE CIRCADIAN CYCLE



Desynchronization occurs when internal rhythms are no longer in tune with external cues or each other. Continuous operations, transmeridian travel (jet lag) and sleep deprivation (as found in SUSOPS) all force the rhythmic systems of the body to re-adapt.

Systems shift their phases at different rates and therefore may not only be out of phase with local time (external desynchronization) but also out of phase with each other (internal desynchronization). Some phases will be phase delayed and others phase advanced. Finally, there are substantial individual differences. For example, extroverts tend to readjust faster than introverts and individuals over age 40 take more time to readjust than the same person would at age 20. People who live on a more regimented schedule appear to have an easier time adjusting than a person who eats, sleeps, etc. when he or she feels like it. **Fortunately, the military aviator is normally younger and tends toward regimentation and extroversion.**

On an average circadian cycle, performance peaks between 1200 and 2100 hours (normally around 1600) and falls to a minimum between 0300 and 0600 hours. Many body rhythms are tied to sleep rather than the temperature cycle and by disrupting sleep these other cycles are also affected.

About seven consecutive days of shift work are required to adjust the body temperature cycle (and the associated performance peaks and valleys). A single period of night work is more easily tolerated than three or four consecutive nights (which starts the process of circadian desynchronization) (7).

Continuous and sustained operations are prime culprits in causing circadian desynchronization. The resultant fatigue can be more difficult to manage as the body is now challenged both internally and externally. This is known as “operational fatigue.”

Fatigue

EASY TO UNDERSTAND BUT DIFFICULT TO DEFINE

Fatigue is something we all have experienced in varying degrees. Unfortunatley, given its multi-faceted nature, a clear and concise definition remains elusive. We will therefore discuss some of the qualities of fatigue as described by Krueger (8) and offer three working definitions applicable in the military setting.

Physical fatigue is the temporary loss of the power of muscles (or sensors) to respond. Mental fatigue includes the subjective feeling of weariness followed by worsening performance of cognitive tasks.

One characteristic of mental fatigue is "an aversion to effort." During prolonged difficult tasks Krueger describes how "...we often see fatigued workers suddenly stop their work, be it physical or cognitive, and vigorously participate in sporting activities, or computer games during 'break'."

Also seen are occasional periods of no response to stimulation but with normal functioning between. This has been described as the "lapse hypothesis" and while not fully understood, explains why vigilance and attention are early casualties of fatigue.

The subjective sense of fatigue is the first indicator that people are getting tired. **In a normally close knit squadron interpersonal dynamics, in particular everyone's sense of humor, may be the first thing to change.** As a management tool this can be a useful hint for the commanding officer.

TYPES OF FATIGUE

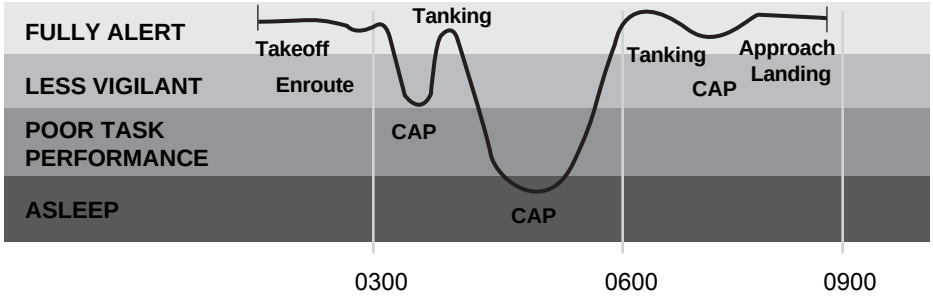
Working definitions which provide a starting point in the operational setting:

ACUTE
- produced by physical exertion or sleep loss
- alleviated by a single rest or sleep period

CHRONIC
- depression or "chronic fatigue syndrome"
- a medical or psychological problem

OPERATIONAL
- attributed to physiological as well as psychological factors
- sleep loss and circadian desynchronization are prime culprits
- the type of fatigue produce by continuous operations
- most commonly seen after 3-4 days of heavy tasking
- not relieved by a single sleep period

FIGURE 1 – PERFORMANCE EFFECTS OF FATIGUE
An Already Tired Aviator Flying an Uneventful Seven Hour Combat Air Patrol (CAP)



Performance

FOR THE MILITARY AVIATOR PERFORMANCE IS THE BOTTOM LINE

Poor performance is the cost of fatigue. At the extreme is disorientation, overwhelming sleepiness and inability to give and receive orders as described during the Normandy operation of WWII. It would be unusual for the tactical aviator to ever get to this point. More likely is that some intermediate level of fatigue and compromised performance will occur.

It is not possible to give a single value or quantity to describe how performance degrades as a result of fatigue. There is no physiologic equivalent to a fuel state or energy on an airframe. The many things that must be considered include: the type of task, preload of fatigue, time of day (circadian effects) and state of arousal.

FOUR DETERMINANTS OF PERFORMANCE

TYPE OF TASK – Takeoff and landing skills are more fatigue resistant than maintaining vigilance

PRELOAD – How tired you were when you started

TIME OF DAY – Performance is best 1200 to 2100 and at a low 0300 to 0600

AROUSAL – What is happening during the flight.

All things being equal you will be more awake flying through AAA than flying circles in the tanker pattern.

Fatigue affects different capabilities at different rates. From most to least sensitive these would generally include: (1) subjective sense of well being, (2) vigilance and attention, (3) judgement and decision making, (4) complex intellectual or physical tasks, and finally, (5) well learned/simple intellectual or physical tasks. Staying awake is sometimes the most important job occurring in an airplane. **Sleeping is the ultimate failure of performance.**

The basic skills of flying an airplane are extremely fatigue resistant. Several studies illustrate this point. Carrier landing during Vietnam actually improved at night after 22 days of combat flying and only slightly worsened during the day (9,10). Likewise LSO scores in Desert Shield/Storm aboard the USS AMERICA remained the same or improved as operations progressed (11). The Army studied three two-man crews who flew a helicopter simulator for 14 hours a day for 4 days and 10 hours on the 5th day while sleeping four hours each night. Cognitive and judgmental errors were made, but pilots flew well into the 5th day (12). Interestingly, flight surgeons deemed the aviators unsafe to fly after the third night. Copilots were noted to increasingly fall asleep due to the boring nature of their duties.

Preload of fatigue is a concept not commonly studied in the laboratory but is extremely valuable when trying to predict how well an aviator will do on a given mission. It is all too easy to focus entirely on what the aviator is about to do and not consider what his schedule was for the past week.

Circadian effects are also important as we previously discussed. The most fatigue sensitive skills (vigilance/attention) are particularly vulnerable to circadian effects.

Different phases of flight have widely varying levels of arousal. Boring aspects might include flying a tanker, helicopter or E-2 on station for several hours, an uneventful combat air patrol, the transit back from a long range strike or holding in the marshal pattern prior to landing. Tasks with high arousal would include bombing a target with the enemy shooting back, engaging a fighter or simply taking-off or landing. **We can predict that performance in situations with inherent arousal will be much better than those that are boring.**

The most likely scenario to produce significant compromise in performance includes an already tired aviator flying between 0300-0600 on an uneventful mission that involves low tasking (no arousal). An example is a seven hour CAP (Combat Air Patrol) mission as shown in figure 1.

Anti-Fatigue Medications

WHILE NOT A SUBSTITUTE FOR WISE MANAGEMENT THERE ARE TIMES TO CONSIDER THIS TYPE OF INTERVENTION

Performance Maintenance Vice Enhancement

An unpleasant image frequently comes to mind when the topic of anti-fatigue medications and aviators is raised. This is of an exhausted pilot who is too tired to fly but is given a high dose of stimulant and repeatedly launched into combat with the expectation that he will perform better than ever before. From this scenario it changes to the aviator suffering from insomnia and other side effects from the stimulant who now requires repeated doses of a sedative to overcome the stimulant medication effects.

This unfortunate scenario represents the extreme of an attempt at **"performance enhancement."** While limited enhancement may be achievable in the future the appropriate use of anti-fatigue medications today is in the role of **"performance maintenance."** Aviators already fly extremely well; the challenge is to identify when fatigue causes periods of degraded performance and then intervene only to maintain an existing level of capability. This intervention would take the form of helping the aviator sleep (thus preventing fatigue) or keeping him awake and alert during the low task phase of a mission.

Non-Pharmacologic Strategies

The use of non-pharmacologic strategies prior to using any medication is essential. This includes deferral of routine non-flying duties, flexible scheduling, and use of frequent naps. "Strategies and Ideas" on page 12 contains specific suggestions for the airwing, squadron, individual aviator and flight surgeon.

History

The use of medications to maintain performance in aviators is not a new idea. During the Falklands conflict sedatives were used by the British to regulate sleep for pilots (13,14). Amphetamines were used by the British (15) and Germans (16) in WWII . During Vietnam both the Air Force and Navy made amphetamines available to aviators. Intermittently since Vietnam up through Desert Storm the Air Force has used both amphetamines and sedatives in selected aircraft for specific missions (17). While not used for performance maintenance, dextro-amphetamine (Dexedrine) was administered frequently in combination with scopalomine to combat motion sickness during primary Navy flight training. A similar combination of meds is currently utilized by NASA to combat space motion sickness during shuttle flights.

Stimulants To Maintain Alertness

Amphetamines have both central and peripheral actions. In the CNS they are a powerful sympathomimetic amine and serve to increase alertness, focus attention, elevate mood, decrease appetite, and improve concentration. Peripherally, both systolic and diastolic blood pressure will be raised with a reflex decrease in heart rate. Dextro-amphetamine (Dexedrine) shows strong central and peripheral effects while methamphetamine has less peripheral action.

At low dosages amphetamines primarily increase alertness with significant side effects only beginning as the doses are increased. Well rested subjects evaluated in the laboratory showed that 5 mg of dextro-amphetamine (Dexedrine) counteracted small performance decrements caused by scopolamine (18). An intermittent low dose regimen, therefore, has the capability of maintaining aviator performance yet avoiding undesired medication effects. **This is consistent with reports from USAF pilots during Desert Storm who stated that 5 mgs of dextro-amphetamine (Dexedrine) helped maintain alertness without causing other changes in mood or perception (19).**

Caffeine is also effective at reversing some of the effects of fatigue. It compares favorably to amphetamine in improving cognitive performance but is **less effective in maintaining alertness (20).** Based purely on efficacy, it is a second choice to amphetamine. Due to its low abuse potential and wide availability, however, caffeine still offers significant utility (especially in ground personnel). Caffeine was used successfully during flights over Iraq supporting Operation Southern Watch in August 1992 (21).

Sleep Initiators

Benzodiazepines produce the "most natural" quality of sleep and are therefore good candidates for sleep initiators. Two significant medication effects are seen: drowsiness (the desired hypnotic action) and amnesia of events during the time the medication has an effect (called anterograde amnesia).

The most significant drawback to benzodiazepines is anterograde amnesia. For the military aviator this raises the possibility of taking the medication, going to a brief,

taking-off and then not remembering what he was told to do. A period of restriction from flight planning, briefing or flying is therefore mandatory following use of benzodiazepines. The restriction for Temazepam (Restoril) is seven hours and is derived from two primary sources. A single laboratory study of a 15 mg dose of temazepam found neither hangover nor amnesia seven hours later (22). Additionally, experience in Desert Storm did not reveal adverse reports from aircrew who flew six to eight hours after using Temazepam (Restoril) (19). A 30 mg dose does not necessarily produce better sleep and has a higher incidence of hangover effect and amnesia (22).

Unfortunately, the demands of strike planning and other non-flying duties may preclude a seven-hour restriction from duty. Another benzodiazepine that has a shorter elimination half-life is Ambien (zolpidem). Mean peak concentrations occur at 1.6 hours after absorption and the mean elimination half-life was around 2.6 hours. The USAF cleared operational forces to use Ambien in 1996. For faster sleep onset it is recommended that Ambien be taken on an empty stomach.

Repetitive Dosing
The risk of drug accumulation from repetitive dosing warrants serious consideration. One pharmacologic rule of thumb suggests that to avoid accumulation dosages need to be repeated at an interval no less than four times the half-live. The maximum acceptable half-life for a medication used daily for extended periods, therefore, is about six hours. The half-lives of the active components or metabolites for dextro-amphetamine (Dexedrine) is about ten hours, Restoril ten hours and Ambien ten hours.

Variability in the half life and metabolism of benzodiazepines and amphetamines is related to the volume of distribution, body fat, drug lipophilicity, and drug elimination. Half life of benzodiazepines is lower in young men because of larger body volume, lower body fat, and active drug elimination. There may be variations in half-life in the population of military aviators due to gender and age. A ground “pretest” of these medications will help each aviator understand their individual effects from the medications and when they specifically notice the onset of effects.

Stimulant Side Effects And Adverse Reactions
Undesired side effects from amphetamine use potentially include increased sleep latency, anorexia, euphoria, hypertension, idiosyncratic reactions, cyclic use of a stimulant/sedative combination to maintain performance or outright abuse (24). These symptoms are primarily dose related and are not expected with 5-10 mgs of dextro-amphetamine (Dexedrine). Insomnia is possible if aircrew use the medication within two hours of sleeping but this can be avoided with appropriate education and training. Idiosyncratic reactions are rare, and should be detected during pretesting. Finally, abuse is possible but felt to be unlikely given the professional nature of aviators, the limited and well defined circumstances within which these medications will be used, and by close aeromedical supervision.

No formal records are available from the use of the scopolamine-Dexedrine combination for motion sickness by the Navy training command. Many years of use, however, did not generate reports of adverse reactions or abuse.

Medication Interactions
Interactions with Chemical Warfare (CW) treatment medications (pyridostigmine, atropine and 2-PAM Chloride) and amphetamines or benzodiazepines are not described by the Drug Therapy Screening System (MICROMEDEX). Caffeine may aggravate arrythmias particularly if used with amphetamines. Benzodiazepines will interact with other CNS depressants, such as alcohol, opiates and antihistamines (diphenhydramine). Temazepam (Restoril) and Ambien should not be taken together.

Importance of Self-Regulation
The delegation of responsibility for use of these medications to the individual aviator, with close follow-up by the flight surgeon is extremely important and the key to success in the operational arena. This principle was strongly emphasized by the Air Force during Desert Storm. If the operational tempo is intense enough to generate significant fatigue, then an overly restrictive medication protocol will probably lose its utility due to lack of flexibility. Aviators, by their nature, are efficient at using tools given to them to achieve specific goals. Anti-fatigue medications are no exception.

Although significant responsibility is delegated to the aviator the amount of medication issued at one time should be limited to what is needed for one or two flights. This allows the flight surgeon to remain closely involved and limits the potential for misuse of the medication either on a one time or recurring basis.

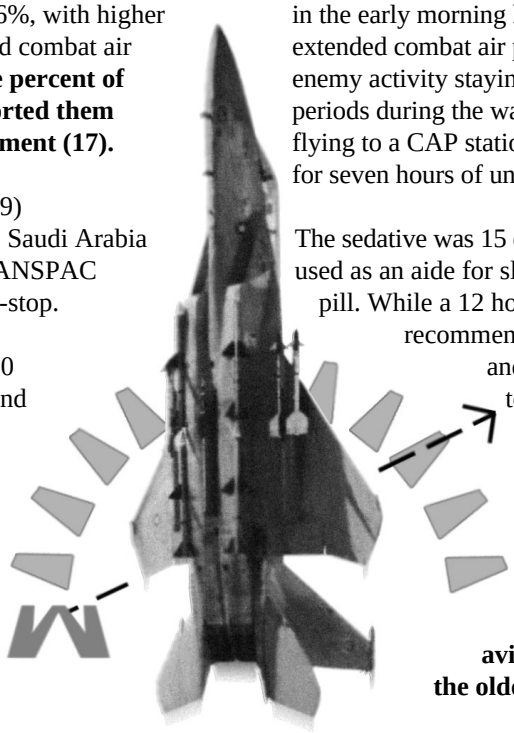
Aircrew Briefings
As the final decision to use stimulants or sedatives is delegated to the aviator his understanding becomes key to the success of the protocol. The need for a quality briefing by the flight surgeon with regular follow-up for advice cannot be overemphasized.

USAF Experience in Desert Storm

AN IN-DEPTH LOOK AT ONE SUCCESSFUL SQUADRON

Background
Stimulant medications dextro-amphetamine ([Dexedrine] 5 mg or recently caffeine 200 mg) were first used in SAC in 1960 and TAC in 1962. While no formal data gathering was done no problems with these stimulants or sedatives are reported. Recently SAC did not use stimulants but authorized Restoril in single/dual seat aircraft. Following Desert Storm an anonymous survey of deployed fighter pilots was completed. 464 surveys were returned (43%). For Desert Storm: 57% used stimulants at some time (17% routinely, 58% occasionally, 25% only once). Within individual units, usage varied from 3% to 96%, with higher usage in units tasked for sustained combat air patrol (CAP) missions. S**ixty one percent of those who used stimulants reported them essential to mission accomplishment (17).**

F-15 Squadron's Experience (19)
This squadron deployed flying to Saudi Arabia as part of Desert Shield with TRANSPAC flights lasting up to 16 hours non-stop. During Desert Storm they flew approximately 7000 hours in 1200 sorties using a pool of 35 pilots and shot down a total of 16 MiG aircraft. It is notable that the squadron had the fewest pilots assigned yet flew more flight hours and shot down more aircraft than any other F-15 squadron in-theater.



Implementation of Anti-Fatigue Medications
Squadron pilots were briefed clearly and completely on the characteristics, recommended dosing, and intended use for both stimulant and sedative medication. Medication, once issued, was considered to "belong to the pilot." The policy of the commanding officer was that all pilots would always fly with stimulant medication available, however, the **decision to use it was left to the individual**. Sedative medication was not allowed to be carried in the airplane to prevent its accidental use in place of stimulant.

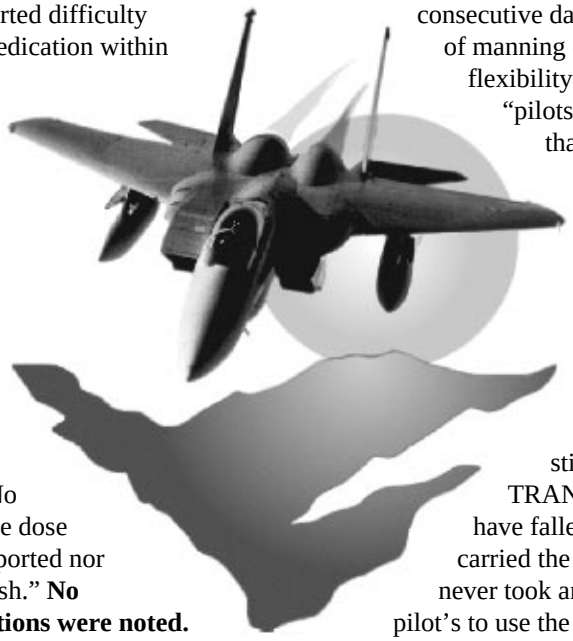
The stimulant, described as the "go-pill", was 5 mg dextro-amphetamine (Dexedrine). The recommended dose was one or two taken orally every four hours. As there is a 45-60 minute delay in onset of effect for the stimulant it was recommended that they use it when the early symptoms of fatigue appeared. They were then given four to six dextro-amphetamine (Dexedrine) tablets which were replaced as needed. In practice most aviators used a 5 mg dose, repeating it every two to three hours. While some took the go-pill outbound on missions with the thought that it would act as a performance enhancer the majority used the medication in the early morning hours or just after sunrise during extended combat air patrol (CAP) missions. If there was enemy activity staying alert was not a problem. For long periods during the war, however, the missions involved flying to a CAP station, circling, then returning to base for seven hours of uneventful flight time.

The sedative was 15 or 30 mg of Temazepam (Restoril) used as an aide for sleep and was called the "no-go" pill. While a 12 hour period of grounding was recommended pilots used this medication and began flight planning within six to eight hours without reporting any adverse effects, including amnesia or "hangover" effect. The no-go pill was used less frequently than the go pill. While based on an extremely limited and subjective sample, it appeared that the **younger aviators favored the go-pills and the older ones the no-go pills.**

Medication use was approved by the commanding officer who was regularly kept apprised by the flight surgeon. Medication was carried personally by the flight surgeon as the pilots were too busy flying or planning to routinely come to sickbay. Additional pills were dispensed as needed with amounts recorded in a small logbook. Frequent visits to the scheduling office and his presence most of the time in the squadron office allowed him to know the aviators' schedules and keep track of individual tasking.

Concerns and Adverse Effects
A number of pilots used more medication than the flight surgeon thought they needed at the time. When the tasking went down, however, their behavior changed and medication use stopped. He has not worried about anyone since and now feels that there was no abuse of either drug, just individual differences.

Insomnia following amphetamine use was not normally seen. Two pilots reported difficulty sleeping when they used the medication within an hour or so of landing. This was due to poor planning or in one case recall of the mission. **Pilots quickly learned the characteristics of the stimulant and used it efficiently.**



When Temazepam (Restoril) was used for insomnia it was usually as a result of work/combat tasking. Cyclic use of stimulants and sedatives in combination was not seen. No tolerance or need to increase the dose of stimulant or sedative was reported nor was there a post-stimulant "crash." **No adverse or idiosyncratic reactions were noted.** While weight loss was common during the war it was not felt to be due to amphetamine induced anorexia. No one reported a reduction in G tolerance. One pilot did report that amphetamine significantly reduced or eliminated the onset of spatial disorientation during aerial refueling at night in bad weather.

Squadron Flight Surgeon Comments
In summary, he felt that both dextro-amphetamine (Dexedrine) and Temazepam (Restoril) were extremely valuable medications during the war. He strongly supports their continued availability for future use as needed.

Squadron Pilots Comments
Individual opinions of the pilots interviewed were either positive or neutral. None expressed a negative opinion regarding the availability or use of either drug. **Several members were adamant that the squadron could not have maintained its level of flight operations without the medications they used.** Those who didn't see any personal benefit still endorsed having it available for others in the squadron.

Operations Officer's Comments
(Navy Exective Officer Equivalent)
The OPSO felt that given the schedule flown the squadron had the potential for "five to ten accidents" yet none occurred. During some 24 hour periods crews were **airborne for thirteen to fourteen hours** with a maximum of six to eight hours off before the next days flying began. An attempt was made to schedule pilots to fly morning, afternoon then night flight on consecutive days to reduce fatigue. The level of manning did not allow as much flexibility as desired. Overall, he felt that "pilots do not like to take drugs" but that in reference to these medications the squadron "just had to have it."

Commanding Officer's Comments
The commanding officer required all pilots to carry Dexedrine on every flight. Personally, he only used the stimulant during the TRANSPAC when he felt he would have fallen asleep. While in-theater he carried the go-pills on every flight but never took any. He didn't encourage his pilot's to use the medication but considered it a **safety-of flight issue**. If they didn't need anything he discouraged its use. He was not aware of any abuse or a "run on the pharmacy." Prior to approving use he discussed the issue with the wing commander who also carried the medication in the airplane.

In his opinion, the main benefit of the medications was to increase or maintain the margin of safety during extremely heavy flight operations. He stated that the level of tasking was not increased based on the use of any medications. When asked about squadron manning he said that 1.25 pilots/aircraft was about right given the normal peacetime funding for training but needed to be increased for combat operations.

His comments on supervision of the aircrew included that **"you must give them guidelines and then let them self-regulate. If you can't trust them with the medication then you can't trust them with a 50 million dollar airplane to try and go kill someone."**

Strategies and Ideas

SUGGESTIONS FOR THE AIR WING, SQUADRON, INDIVIDUAL AND FLIGHT SURGEON

AIR WING LEVEL:

- ❑ Fatigue is a commodity to be managed. This policy/attitude must be established by the air wing commander.
- ❑ Everyone else's resistance to fatigue will rarely be the same as the air wing commander's.
- ❑ Recognize that planning/ground duties fatigue CO's/XO's and department heads prior to the first strike.
- ❑ Minimize unnecessary changes in tasking (weaponeering, rules of engagement, etc.). The cost is lost sleep.
- ❑ Task squadrons/units so they can minimize circadian disruption (allow day or night specialization).
- ❑ Expand facilities support when needed. Examples include longer food service hours, an additional sickcall or augmented base transportation.
- ❑ Optimize sleeping quarters for sleeping (sometimes hard to do). A noisy room is bad, a hot one is worse (make the base or ship fix the A/C).

SQUADRON LEVEL:

- ❑ Fatigue is a commodity to be managed. This policy/attitude must be established by the commanding officer.
- ❑ Preparation/planning for a strike may be harder than the strike itself; don't make it harder than it needs to be.
- ❑ Four to five hours of sleep per night is the minimum required for indefinite sustained operations.
- ❑ A change in squadron dynamics, such as losing a sense of humor, is an early and reliable indicator of fatigue.
- ❑ Kick people out of the ready room and send them to bed; encourage combat naps.
- ❑ It is harder to sleep at mid-day than at 0300; schedule a longer block of time for rest during the day.
- ❑ It takes about seven days to adjust to working nights. Working only three to four nights in a row starts the process of circadian desynchronization but doesn't complete the shift. Therefore, working a single night or seven in a row is better tolerated.
- ❑ Bright lights not only maintain alertness but are a strong factor in accelerating circadian adaptation.
- ❑ Establish "grounding" guidelines for both overly fatigued aircrew and ground support personnel.
- ❑ Let the senior enlisted do the paperwork.
- ❑ Use your flight surgeon.

INDIVIDUAL LEVEL:

- ❑ Decide early to "manage" yourself.
- ❑ Be honest about your limitations; no one can sprint 26 miles.
- ❑ Pay attention to nutrition, hydration and physical conditioning.
- ❑ Exercise sleep discipline; unless it is really important go to bed.
- ❑ Combat naps work (even as short as 10 minutes).
- ❑ Many people are sluggish and confused for five to twenty minutes after taking a nap. This could be a problem when manning an alert aircraft.
- ❑ Ten hours is the maximum effective sleep period (even when sleep deprived).
- ❑ During the day it is easiest to get to sleep just after lunchtime (whether you ate or not).
- ❑ Caffeine works well to keep you awake – so remember to stop drinking coffee several hours before you want to sleep.
- ❑ Consider raising the B.S. flag if you need too.

FLIGHT SURGEON UTILIZATION:

- ❑ The squadron flight surgeon (FS) can be of great value during Continuous Operations and SUSOPS. The FS's familiarity with squadron members and knowledge of the signs and symptoms of fatigue place him in a unique position to assist the squadron.
- ❑ Consider the FS in planning/scheduling/briefing; he may think of things you didn't and can be a good conscience.
- ❑ The FS can be a problem solver by improving the sleep and work areas and general facilities support.
- ❑ The FS can provide the aircrew an "out." An aviator can save face by having his FS ground him verses having to go to the OPSO and admitting that he is too fatigued to fly.
- ❑ Anti-fatigue medications are an additional augment that the FS can provide should operational necessity demand it.

NOMI/NAMRL Medication Protocols

DESCRIPTIONS OF AVAILABLE MEDICATIONS

AUTHORIZATION FOR USE

THE USE OF STIMULANTS OR SEDATIVES IS APPROPRIATE ONLY IN COMBAT OR DURING EXCEPTIONAL CIRCUMSTANCES OF OPERATIONAL NECESSITY

THE COMMANDING OFFICER, FOLLOWING CONSULTATION WITH THE AIR WING COMMANDER (OR HIS EQUIVALENT) AND FLIGHT SURGEON, MAY AUTHORIZE THE USE OF STIMULANTS AND/OR SEDATIVES FOR PILOTS, NFO'S AND AIRCREWMEN. THE FLIGHT SURGEON WILL CONSULT WITH HIS SUPERVISOR IN THE AEROMEDICAL CHAIN-OF-COMMAND.

CHECKLIST FOR ADMINISTRATION

1. Ground testing must be completed prior operational use of dextro-amphetamine (Dexedrine), Ambien or Temazepam (Restoril). No flying will be done the day of the pretest. Both the SF-600 overlay and the Informed Consent form will be completed, signed by the member and placed in the medical record.

2. Fully brief all aviators and supervisory personnel on the proper use of medications and possible side-effects.

3. Ensure the Commanding Officer has properly authorized use of the medication. Consult with your own supervising medical officer.

4. Issue the stimulant in amounts required for one or two flights and document with an SF-600 entry. Sedatives will not be carried in the airplane to preclude inadvertent use.

5. Closely monitor medication use and aviator fatigue by being present as much as possible in the ready room. Pay particular attention to possible interactions with over-the-counter medications.

6. Collect unused medication at the end of continuous operations.

7. Submit a report to the Chairman of the Aeromedical Advisory Council, Naval Operational Medicine Institute, describing both the operational tasking and use of anti-fatigue medications.

Commanding Officer
NOMI (Code 42)
220 Hovey Rd
Pensacola, FL 32508-1047

STIMULANTS

Indications: Excessive drowsiness affecting flight safety.

Desired Effects: Increased alertness, maintenance of baseline performance.

Administration: Issued to the pilot after pre-testing and briefing by the flight surgeon on use and side-effects. Signed Informed Consent form must be completed prior to issuance of dextro-amphetamine (Dexedrine) tablets. Only an amount of medication required for one or two flights should be issued. This provides automatic follow-up for re-evaluation if the aviator is experiencing significant fatigue.
Use of the medication is voluntary.

Accumulation: May occur if the recommended dosage schedule is exceeded. This may lead to delayed sleep after a mission.

Other Meds: Other medications under investigation include demoline (Cylert), methylphenidate (Ritalin), methamphetamine, and modafanil.

DEXEDRINE (dextro-amphetamine)

Dosage: 5 mg, repeat in 15 minutes if needed. Follow with 5mg every 2 hours if required. Not to exceed 30 mg per 24 hour period.

Side Effects: Primarily dose related. Central effects include insomnia, euphoria, anorexia and channelized attention. Abuse is possible but considered unlikely in an operational setting in the population of military aviators. Elevated systolic and diastolic blood pressure with a reflex decrease in heart rate may be seen at higher doses. Effects on G-tolerance are not known. A rise in body temperature may also be seen.

Considerations:
– Proven efficacy and safety in operational use.
– Available in the supply system.
– Side effects unlikely at low doses.
– May produce insomnia if taken close to bedtime.

SEDATIVES

Indications: Insomnia due to anxiety, stress or need to sleep at mid-day.

Desired Effects: Initiation or maintenance of sleep.

Administration: Issued to the pilot after briefing by the flight surgeon on use and side-effects. Only the amount of medication required for near term operations should be issued. This provides automatic follow-up for re-evaluation if the aviator is experiencing significant insomnia. ***Use of the medication is voluntary.***

Accumulation: Accumulation may occur if the recommended dosage schedules are exceeded.

Coordination: Prior to issuing sedatives, the Commanding Officer must be fully aware of the length of time that aircrew will not be available for planning, briefing or flying after using the medication.

Other Meds: Other medications under investigation include melatonian and tryptophan.

AMBIEN (zolpidem)

Dosage: 5 or 10 mg. Maximum of 10mg per 24 hour period.

Restrictions: – No planning, briefing or flying for 6 hours post dose.
– Will not be carried in the aircraft to preclude inadvertent use.

Side Effects: – Drowsiness
– Amnesia of events while therapeutic levels present (anterograde amnesia).

Considerations: Shorter restriction from planning, briefing or flying is an advantage over temazepam.

RESTORIL (temazepam)

Dosage: 15 mg per 24 hour period. No more than 2 days of consecutive use.

Restrictions: – No planning, briefing or flying for 7 hours due to the risk of anterograde amnesia.
– Will not be carried in the aircraft to preclude inadvertent use.

Side Effects: Amnesia of events while therapeutic levels present (anterograde amnesia).

Considerations: – Benzodiazepines are the best of the pharmacologic sleep aids.
– Accumulation is a potential problem if the administration schedule is exceeded.
– **30 mg does not produce better sleep and has a longer period of hangover/amnesia**.
– **Aviators must be fully briefed on the risk of anterograde amnesia.**

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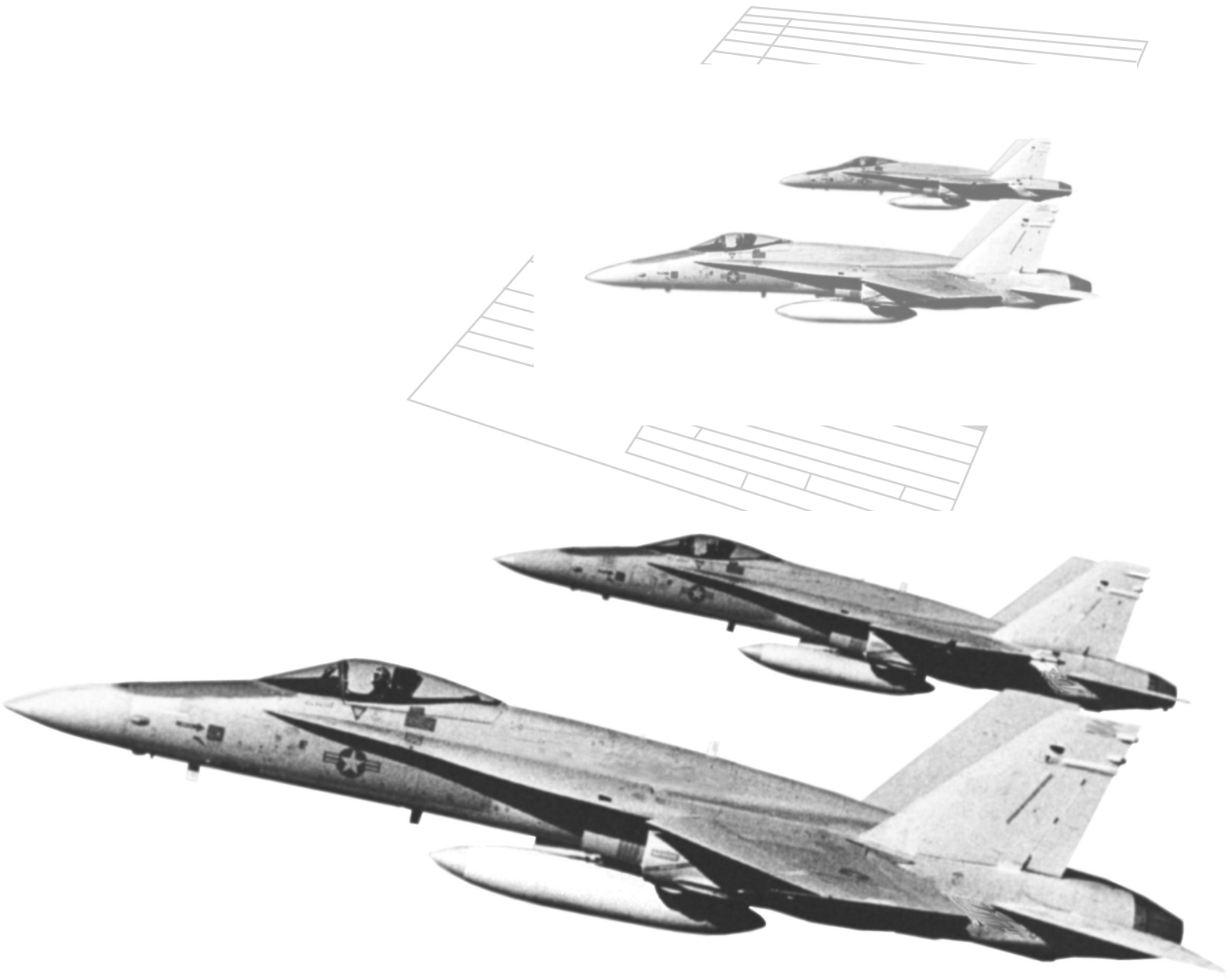
Pretesting Consent Form and Operational Use Consent Form

SF-600 OVERLAYS



NSN 7540-00-634-4178

HEALTH RECORD	CHRONOLOGICAL RECORD OF MEDICAL CARE
DATE	SYMPTOMS, DIAGNOSIS, TREATMENT TREATING ORGANIZATION *(Sign each entry)*

SPECIAL SF-600 – PRETESTING CONSENT FORM

PERFORMANCE MAINTENANCE STIMULANT

Selected medications are effective in overcoming fatigue during flight in combat and other sustained operations. Pretesting with the appropriate stimulant prior to operational use allows aviators to familiarize themselves with the medication and discover any untoward side effects. Use of these medications, *including this pretest*, is voluntary at all times. There will be no flying during the 24 hours of the pretest. No other medications, including over-the-counter medications, should be taken. Keep caffeine and tobacco use to a minimum. Report any adverse effects to your flight surgeon.

HAVE YOU EVER HAD ANY OF THE FOLLOWING?

YES	NO	
☐	☐	High blood pressure
☐	☐	Racing, pounding or irregular heart beat
☐	☐	History of drug or alcohol abuse

I have read and understand the pretest consent instructions.

Aviator Signature: _____ Date: _____

Medication and Dosage: _____ Date: _____

Adverse Reactions: _____

Flight Surgeon Signature: _____ Date: _____

PATIENT'S IDENTIFICATION *(Use this space for Mechanical Imprint)*

RECORDS MAINTAINED AT: ▶		
PATIENT'S NAME *(Last, First, Middle Initial)*		SEX
RELATIONSHIP TO SPONSOR	STATUS	RANK/GRADE
SPONSOR'S NAME		ORGANIZATION
DEPART./SERVICE	SSN/IDENTIFICATION NO.	DATE OF BIRTH

STANDARD FORM 600 (REV. 5-84)
Prescribed by GSA and ICMR
FIRMR (41 CFR) 201-45.505

INFORMED CONSENT
FOR
OPERATIONAL USE OF DEXEDRINE

It has been explained to me and I understand that the US Food and Drug Administration has not approved the use of Dexedrine to manage fatigue. However, I understand that Dexedrine previously has been approved for the treatment of sleeping disorders, obesity, and attention deficit disorder. Subsequently, it has also been found effective in treating the symptoms of chronic fatigue. I understand that it is for the benefit of controlling the symptoms of chronic fatigue that I have been provided a single dosage of the medication. I further understand that the decision to take this medication is mine alone.

In addition, I understand that possible common side effects of Dexedrine include Insomnia, nervousness, and appetite loss. Possible gastrointestinal disturbances include diarrhea, constipation, and /or dryness of the mouth. Other known, less common side effects include rapid heartbeat, heart palpitations, elevation of blood pressure, tremor, headache, euphoria, depression. Addiction and tolerance are also risked through prolonged use at increased dosages.

I have also been informed and understand that use of Dexedrine simultaneous with the use of certain other prescription or over-the-counter medications is not advised. * I have informed the flight surgeon of any other medications I am taking at this time.

My decision to take Dexedrine is voluntary. I understand that I am not being required to take the medication. Neither can I be punished if I decide not to take Dexedrine. However, should I choose not to take it under circumstances where its use appears indicated, I understand safety considerations may compel my commander, upon advise of the flight surgeon, to determine whether or not I should be considered unfit to fly a given mission.

I understand that a copy of this notice shall be inserted in my medical record. If I have any questions with regards to the administration of Dexedrine, I will raise them with the flight surgeon.

Member's Signature and SSN _____ Date _____

* Use of the following other drugs and compounds simultaneous with Dexedrine is not advised: herbal compounds, glutamic acid, ascorbic acid (fruit juices, Vit C), antacids composed alkalinizing agents (sodium bicarbonate, other gastrointestinal and urinary alkalinizing agents), antihistamines, Thorazine (chlorpromazine, a tranquilizer/anti-emetic), Zarontin (ethosuximide, an anti-convulsant), haloperidol (anti-psychotic), anti-hypertensives, Demerol (meperidine), Norepinephrine (for extreme hypotension), Phenytoin (Dilantin, ant-seizure medication), propoxyphene (Darvon, analgesic), beta-adrenergic blockers (hypertension, ventricular dysrhythmias, prophylaxis of angina pectoris), digitalis medications, lithium carbonate, tricyclic/sympathomimetic antidepressants, MAO antidepressants (monoamine oxidase inhibitors).